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(71) Applicant(s)

NEC Corporation
(Incorporated in Japan)
7-1 Shiba 5-chome, Minato-ku, Tokyo 108-01, Japan

(72) Inventor(s)

Shinichi Miyazaki

(74) Agent and/or Address for Service

Mathys & Squire
100 Grays Inn Road, LONDON, WC1X 8AL,
United Kingdom

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GB 2292286 A

(58) Field of Search

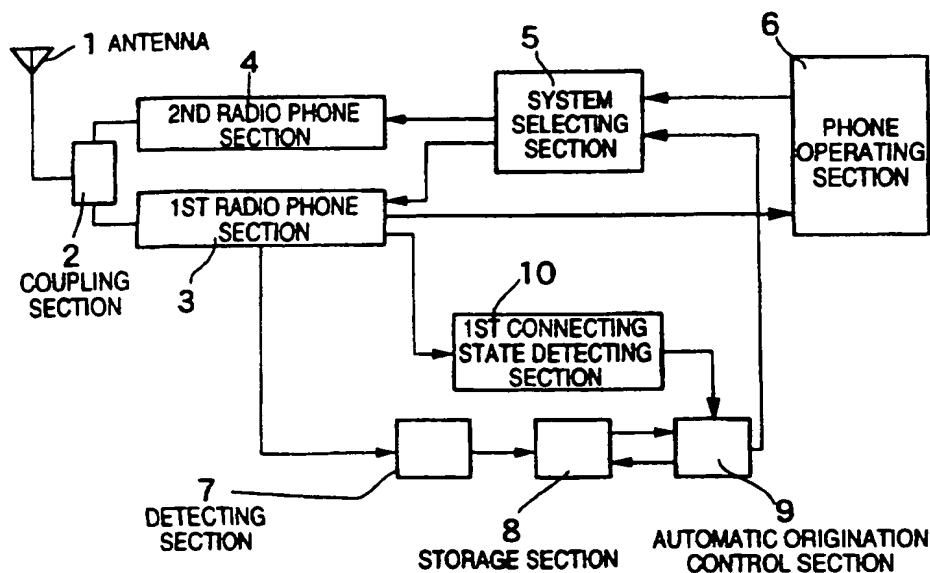
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(54) Abstract Title

Mobile phone with automatic switching between different radio systems

(57) A mobile phone which is operable on more than one system, for example cellular and PHS, automatically establishes a communication link with the second system according to a communication state of the first communication system. The communication state may be the received signal strength from the first system. The phone may store the destination number of a call in progress to enable a connection to be established via the second communication system. One of the communication systems may be established as a preferred system.

Fig. 1



GB 2 333 934 A

Fig. 1

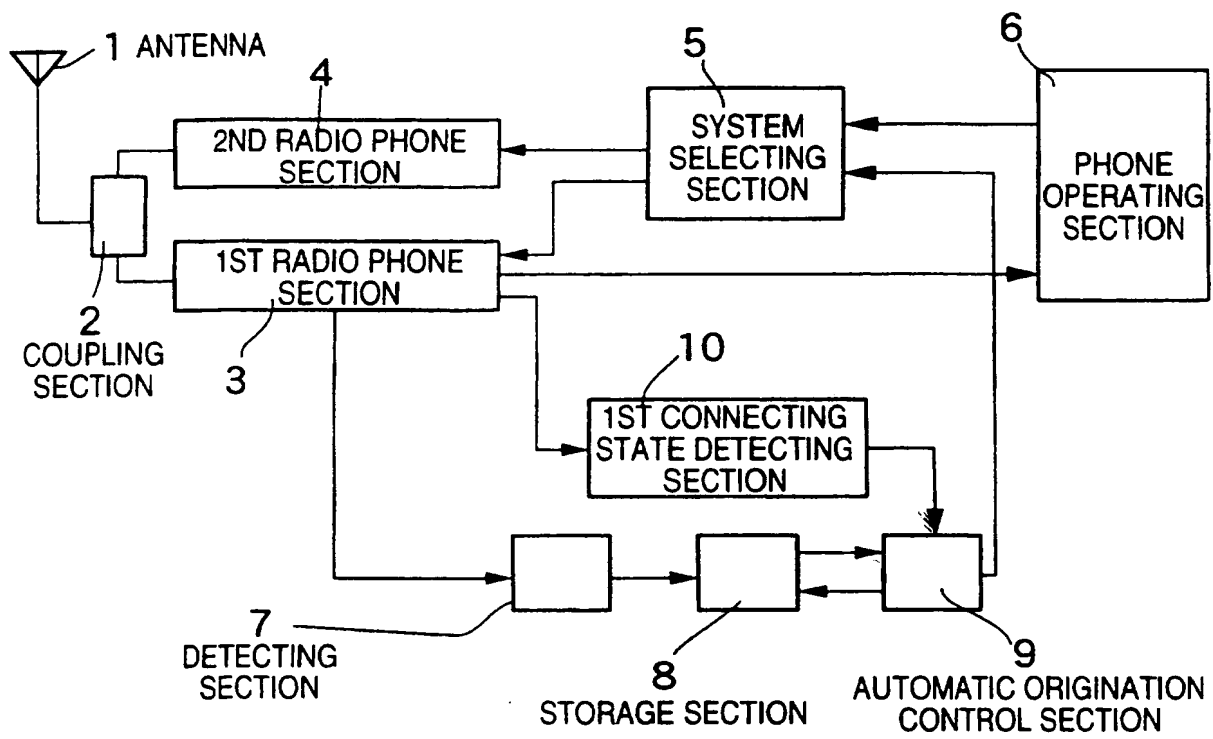


Fig. 2

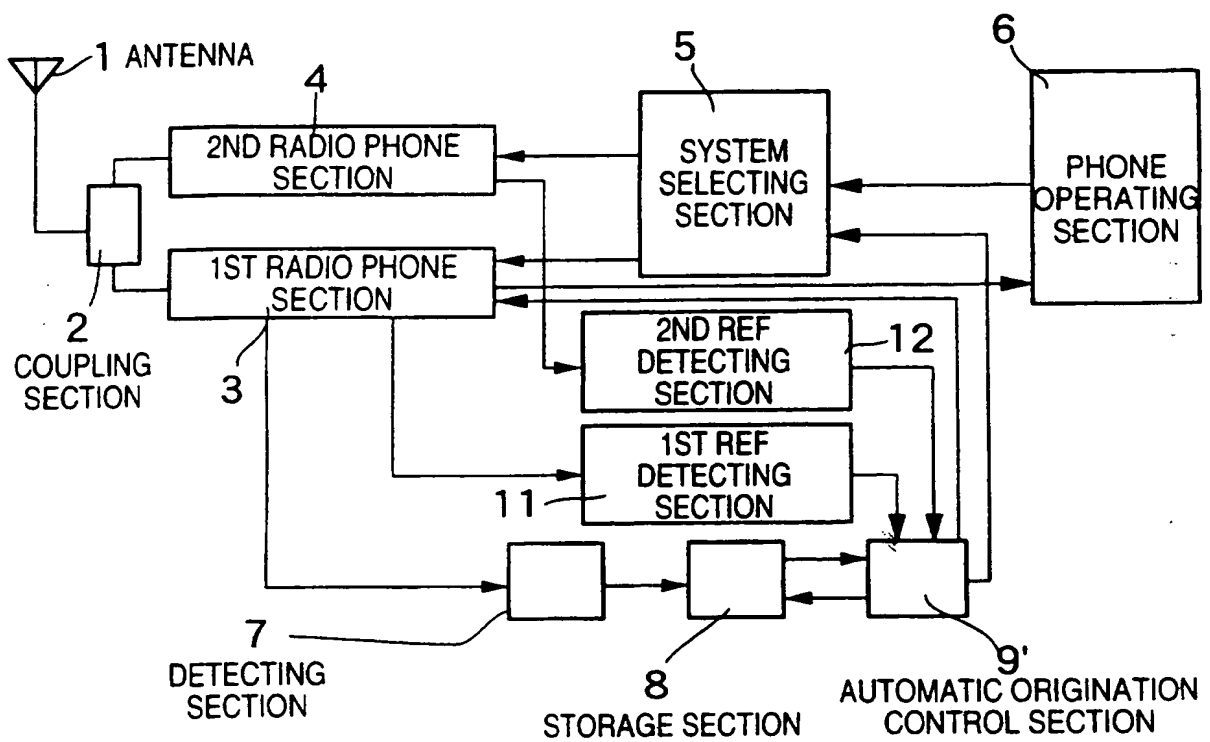


Fig. 3

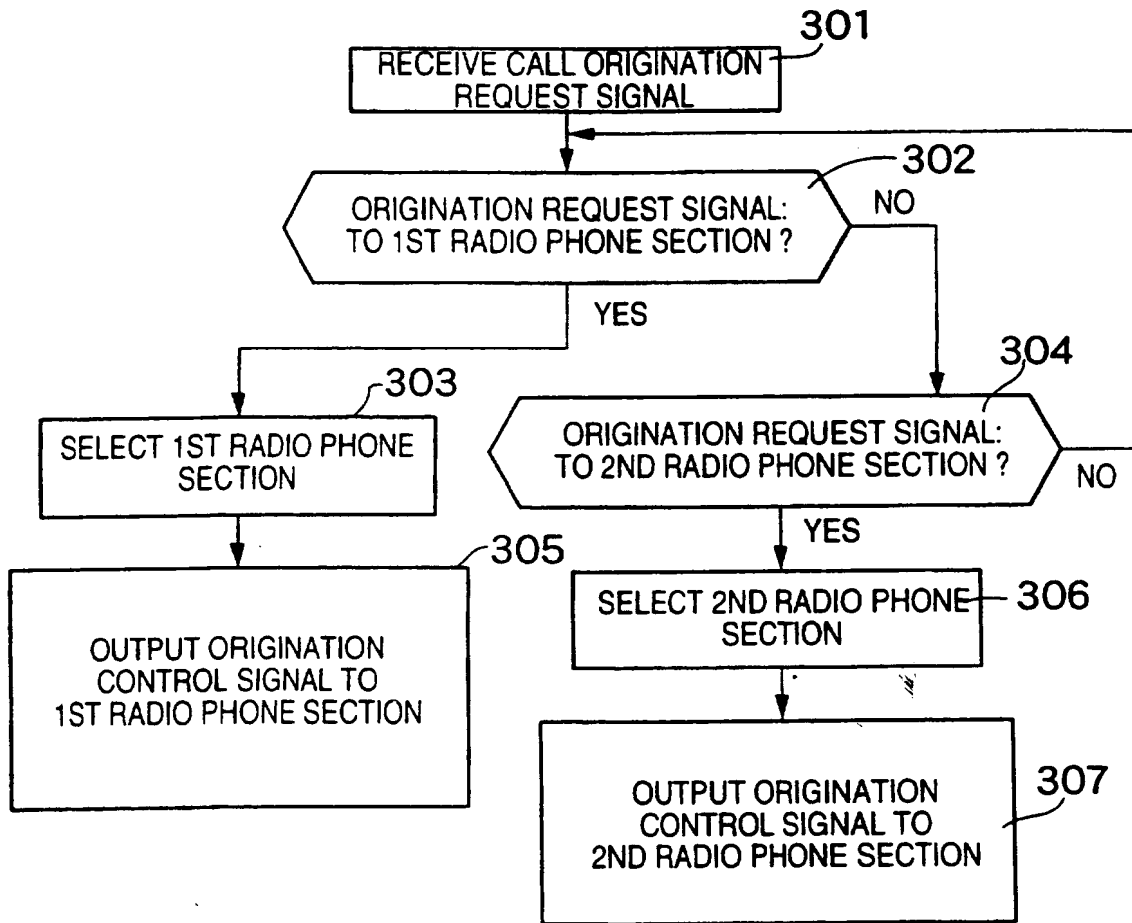


Fig. 4

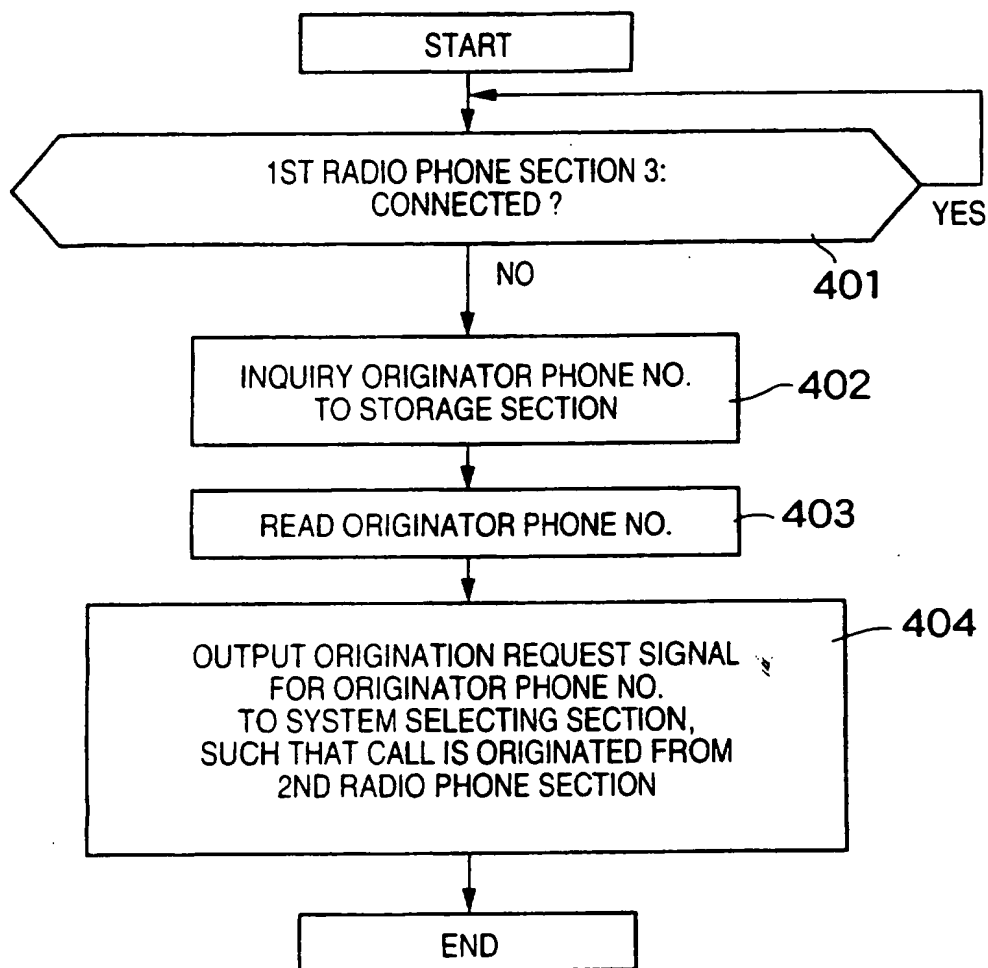


Fig. 5

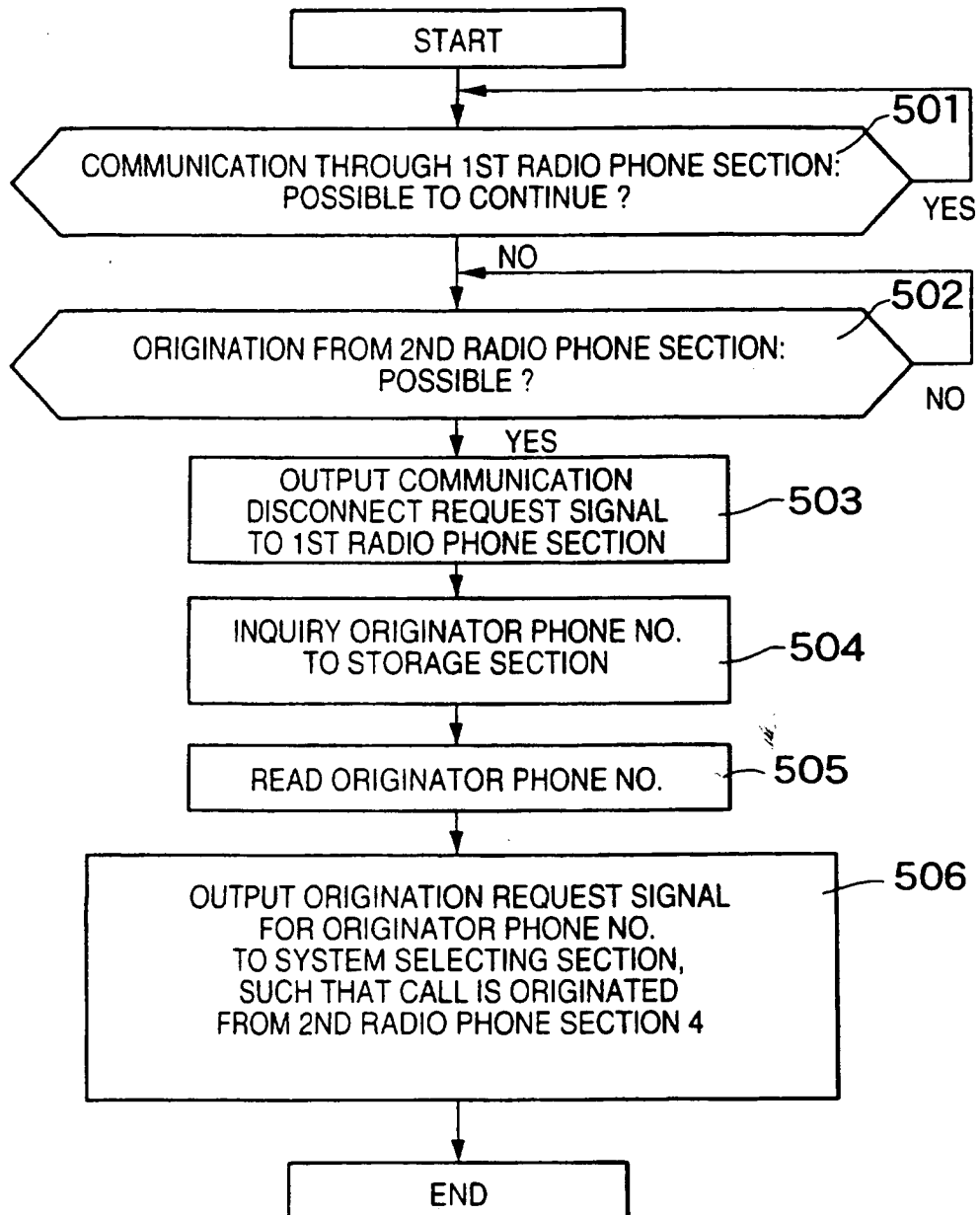


Fig. 6

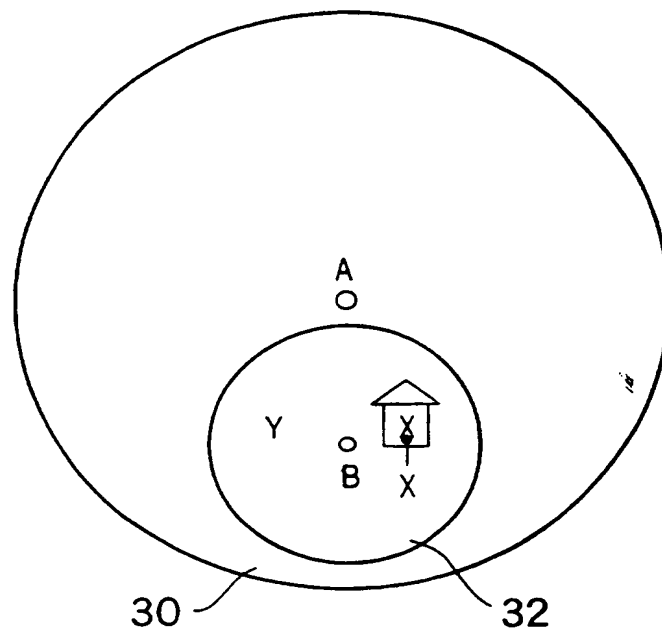
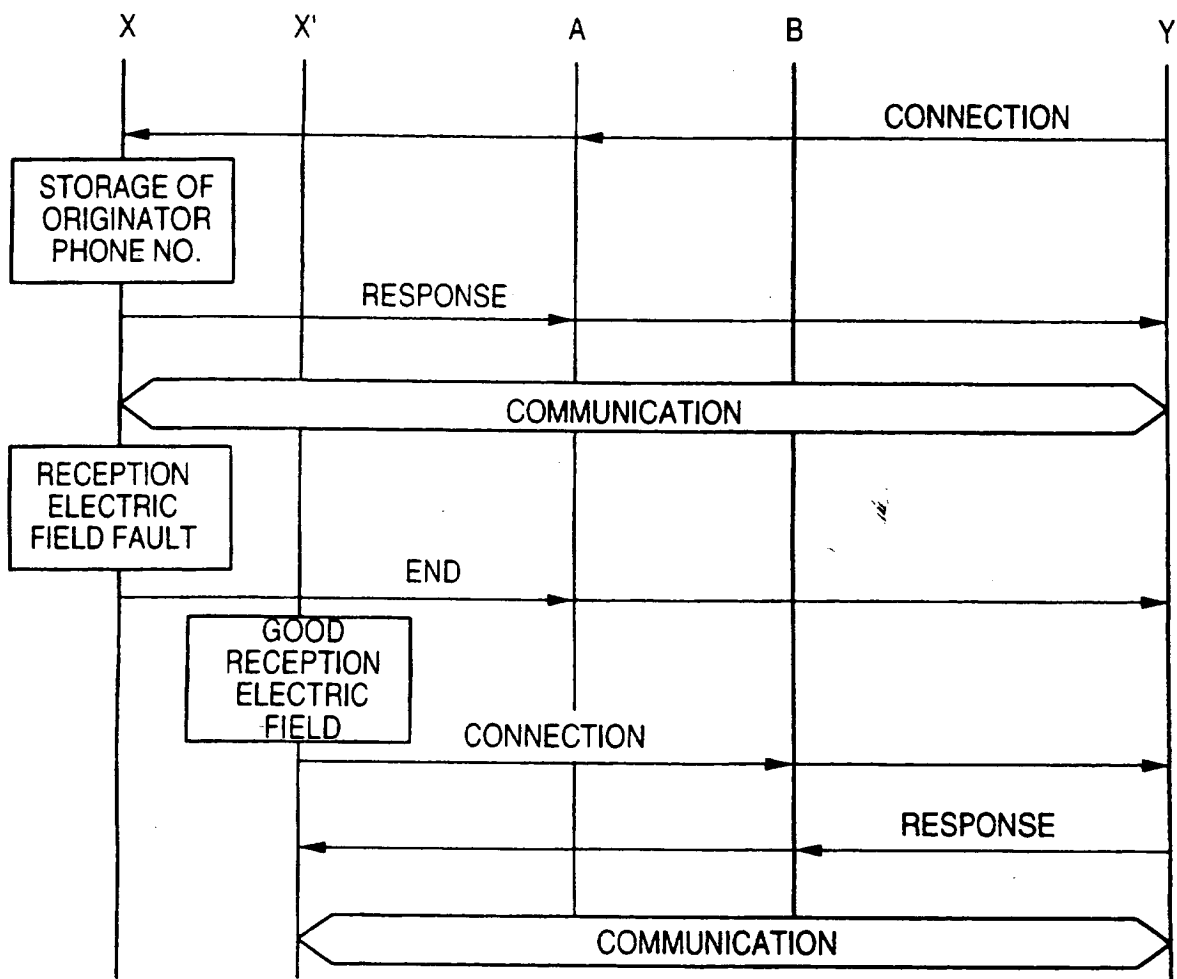


Fig. 7



Background of the Invention

1. Field of the Invention

5 The present invention relates to a mobile phone, and more particularly to a mobile phone operable with two different radio phone systems.

2. Description of the Related Art

10 In a mobile phone system, a plurality of base stations are arranged in respective areas provided at a predetermined interval. A mobile phone selects the area having the strongest reception electric field intensity one
15 after another so that communication is made possible during movement of the phone. However, there is a case that the reception electric field intensity decreases within one area depending upon the position of the mobile phone due to geographical
20 conditions such as a tunnel, a high building, and another radio source. In such a case, as a result, enough signal noise ratio (SNR) cannot be obtained due to noise, resulting in the state which the communication cannot be continued. In
25 this case, it is necessary that the communication is ended and then communication line re-connection is performed after the reception

electric field intensity is recovered to a sufficient level.

In a recent portable digital phone (PDC) in Japan, an automatic re-dial call originating
5 function is performed when the reception electric field intensity becomes weak so that a communication line is disconnected. A line re-connection system is described in Japanese Laid Open Patent Application (JP-A-Heisei 5-37456) as
10 a first conventional example. In the automatic re-dial call origination function of the reference, after a phone number is inputted by a user, a call is originated to a destination phone number. For example, in a call connecting system
15 of a mobile phone system, the destination phone number is stored when the line connection with the destination is established. Then, when the communication line is disconnected compulsory by the decrease of the reception electric field
20 intensity during the communication, the automatic re-dial call originating function is performed based on the stored destination phone number.

Also, a portable telephone system is described in the Japanese Laid Open Patent
25 Application (JP-A-Heisei 1-174029) as a second conventional example. In the reference, when a user of a portable phone is not in an area where

electromagnetic wave can be received from a base station, a call arrival and an origination side phone number are informed to the portable phone, after the user moves to another area where the portable phone can receive the electromagnetic wave from the base station.

Also, a telephone with an origination portable phone number switching function is described in Japanese Laid Open Patent Application (JP-A-Heisei 9-98485) as a third conventional example. In this reference, when a switching button is operated because a user is out of a communication area, an origination side phone number which has been stored temporarily in an origination side phone number storage section is updated in accordance with a predetermined procedure. Then, after a communication line is disconnected once, the updated origination side phone number is read and is automatically sent out to the origination side.

However, in the first conventional example, the re-dial call origination is performed by use of the system which has detected the decrease of the reception electric field intensity.

Generally, the reception electric field intensity is continuously weak in many cases other than the case of the short-term electromagnetic wave fault

such as building shade. Therefore, the reconnection of the communication line is frequently difficult.

Also, in the second conventional example, even if the destination side phone number is informed before the communication line is disconnected, a line connecting operation must be manually performed again.

Further, in the third conventional example, if the area in which the user is present is not changed, there is no meaning to operate the switching button.

Summary of the Invention

An object of the present invention is to provide a mobile phone in which communication conducted using one phone system can be restarted even when line reconnection using that phone system is difficult.

In a first aspect, the present invention provides a mobile phone comprising:

- an antenna;

- a first radio phone section connected to said antenna, and corresponding to a first radio phone system;

- a second radio phone section connected to said antenna, and corresponding to a second radio phone system different from said first radio phone system;

- detecting means for detecting a communication state between a destination and that one of the radio phone sections currently being used; and

- control means for disconnecting a first communication line between the destination and the currently used radio phone section based on the communication state detected by said detecting means and for controlling the other of said radio phone sections to establish a second communication line between said

destination and the other radio phone section.

In a preferred embodiment of this aspect of the present invention, a mobile phone includes an antenna, a first radio phone section connected to the antenna, and corresponding to a first radio phone system, and a second radio phone section connected to the antenna, and corresponding to a second radio phone system different from the first radio phone system. A first state detecting section detects a communication state between a destination and a current use radio phone section as one of the first radio phone section and the second radio phone section. The other is an alternate radio phone section. A control section controls the current use radio phone section to disconnect a first communication line between the destination and the current use radio phone section based on the detecting result by the state detecting section. Also, the control section controls the alternate radio phone section to establish a second communication line between the destination and the alternate radio phone section.

The mobile phone may further include a second state detecting section for determining whether the establishment of the second communication line between the destination and the alternate radio phone section is possible, and for outputting a call possible signal when it is determined that the establishment of the second communication line between the destination and the alternate radio phone section is possible. The control section controls the alternate radio phone section to establish the second communication line between the destination

and the alternate radio phone section in response to the call possible signal.

One of the first radio phone section and the second radio phone section may be
5 predetermined as the current use radio phone section, or may be determined as the current use radio phone section based on a system specification data inputted by a user.

The first state detecting section may output a
10 line disconnect signal based on a first reception electric field intensity received by the current use radio phone section. More specifically, the first state detecting section may output the line disconnect signal when the first reception
15 electric field intensity is lower than a predetermined level. In this case, the control section controls the current use radio phone section to disconnect the first communication line between the destination and the current use
20 radio phone section in response to the line disconnect signal.

Also, the second state detecting section may output the call possible signal based on a second reception electric field intensity
25 received by the alternate radio phone section. More specifically, the second state detecting section may output the call possible signal when the

second reception electric field intensity is lower than a predetermined level. In this case, the control section controls the alternate radio phone section to connect the second communication
5 line between the destination and the alternate radio phone section in response to the call possible signal.

The mobile phone may further include a phone number storage section for storing a phone
10 number of the destination. In this case, the control section reads out the destination phone number from the phone number storage section and controls the alternate radio phone section to establish the second communication line between
15 the destination and the alternate radio phone section based on the read out destination phone number. Also, the mobile phone may further include a phone number detecting section for detecting the destination phone number from a
20 call arrival signal for a call originated from the destination and for storing the destination phone number in the phone number storage section. Further, the phone number detecting section may store the destination phone number in the phone
25 number storage section when the first communication line is established between the destination and the current use radio phone

section in response to a call origination using the current use radio phone section.

The control section may include a system selecting section for selecting the current use radio phone section from the first radio phone section and the second radio phone section based on a first system specification data and the alternate radio phone section from the first radio phone section and the second radio phone section based on a second system specification data and an automatic call origination control section for automatically outputting the second system specification data to the system selecting section based on the detecting result by the first state detecting section.

One of the first radio phone section and the second radio phone section may be a radio phone section which corresponds to a PHS system and the other radio phone section may be a radio phone section which corresponds to a PDC system. Instead, one of the first radio phone section and the second radio phone section may be a radio phone section which corresponds to a cellular phone system and the other radio phone section may be a radio phone section with corresponds to a PCS system.

In a second aspect, the present invention provides a method of controlling communication between a destination and a mobile phone, said method comprising the steps of:

- performing establishment of a first communication line between a destination and a currently used radio phone section;

- detecting a communication state between said destination and said currently used radio phone section;

- disconnecting said first communication line between the destination and said currently used radio phone section based on the detected communication state; and

- performing establishment of a second communication line

between said destination and another radio phone section when said first communication line is disconnected based on the detected communication state between said destination and said currently used radio phone section.

In a preferred embodiment of this aspect of the present invention, a method of communicating with a destination in a mobile phone, includes the steps of:

performing a first establishment of a first communication line between a destination and a current use radio phone section, wherein one of a plurality of radio phone sections is the current use radio phone section and another of the plurality of radio phone sections is a substitutive radio phone section;

detecting a communication state between the destination and the current use radio phone section;

disconnecting the first communication line between the destination and the current use radio phone section based on the detecting result of the communication state between the destination and the current use radio phone section; and

performing a second establishment of a second communication line between the destination and the substitutive radio phone section when the first communication line is disconnected based on the detecting result of the communication state between the destination and the current use radio phone section.

Preferred features of the present invention will be described below, by way of example only, with reference to the attached drawings, in which:-

Fig. 1 is a block diagram illustrating the structure of the mobile phone according to a first embodiment of the present invention;

Fig. 2 is a block diagram illustrating the structure of the mobile phone according to a second embodiment of the present

invention;

Fig. 3 is a flow chart illustrating the operation of a system selecting section 5 in the mobile phone according to the first embodiment of the present invention;

Fig. 4 is an operation flow chart of an automatic origination control unit 9 of the mobile phone according to the first embodiment of the present invention;

Fig 5. is an operation flow chart of an automatic origination control unit 9 ' of the mobile phone according to the second embodiment of the present invention;

Fig. 6 is a diagram to explain the operation of the mobile phone according to the second embodiment of the present invention; and

Fig. 7 is a sequence diagram to explain an operation of the mobile phone according to the second embodiment of the present invention.

Description of the Preferred Embodiments

A mobile phone of the present invention will be described below in detail with reference to the attached drawings.

5 Fig. 1 is a block diagram illustrating the structure of the mobile phone of the first embodiment of the present invention. The mobile phone is composed of an antenna 1, a coupling section 2, a first radio phone section 3, a
10 second radio phone section 4, a system selecting section 5, a phone operating section 6, an originator phone number detecting section 7, an originator phone number storage section 8, an automatic call origination control unit 9 and a
15 first connecting state detecting section 10.

As mentioned above, the mobile phone
is composed of the first radio phone section 3 to be connected to a first mobile phone system and the second radio phone
20 section 4 to be connected to a second mobile phone system. As a result, the mobile phone can be connected to the two radio phone systems. In this embodiment, it supposed that a PHS system is adopted as the first mobile phone system and a
25 portable digital phone (PDC) system is adopted as the second mobile phone system, for example.

Also, both of the first radio phone section

3 and the second radio phone sections 4 are connected to the antenna 1 through the coupling section 2. The first radio phone section 3 and the second radio phone section 4 can be connected to the respective systems at the same time. Also, the mobile phone is composed of the phone operating section 6 for operations necessary to perform a call origination and a call arrival. The phone operating section 6 has numeral keys and various function keys as operation elements. When the phone operating section 6 has a speech recognition system, various data or instructions may be inputted by voice.

When a call is originated, a system specification data is inputted from the phone operating section 6 to specify one of the systems which is to be used for the call origination. Also, a destination phone number is inputted from the phone operating section 6. Subsequently, the phone operating section 6 outputs a call origination request signal to the system selecting section 5 together with the system specification data and the destination phone number.

Next, an operation of the system selecting section 5 will be described with reference to a flow chart of Fig. 3.

When receiving the call origination request signal (Step 301), the system selecting section 5 selects one of the first radio phone sections 3 and the second radio phone sections 4 as a current use radio phone section based on the system specification data in response to the call origination request signal. Then, the system selecting section 5 outputs the destination phone number and a call origination control signal to the current use radio phone section.

More particularly, in a step 302, the system selecting section 5 determines whether or not the first radio phone section 3 is selected. If the answer is YES, the system selecting section 5 selects the first radio phone section 3 as the current use radio phone section in a step 303. Subsequently, the system selecting section 5 outputs the call origination control signal and the destination phone number to the current use radio phone section 3. The first radio phone section 3 originates a call through the coupling section 2 and the antenna 1 based on the destination phone number in response to the call origination control signal. Thus, the communication is made possible by use of the first radio phone section 3.

On the other hand, if the answer is NO in

the step 302, the control advances to a step 304 to determine whether or not the call origination request is to the second radio phone section 4. If the answer is NO in the step 304, the control
5 returns to the step 302. If the answer is YES in the step 304, that is, if the call origination request is to the second radio phone section 4, the system selecting section 5 selects the second
10 radio phone section 4 as the current use radio phone section in a step 306. Subsequently, the system selecting section 5 outputs the call origination control signal and the destination phone number to the second radio phone section 4 in a step 307. The second radio phone section 4
15 originates a call through the coupling section 2 and the antenna 1 based on the destination phone number in response to the call origination control signal. Thus, the communication is made possible by use of the second radio phone section
20 4.

Next, the call arriving operation when a call is received by the first radio phone section 3 will be described.

First, it is supposed that the first radio
25 phone section 3 receives a call arrival signal through the antenna 1 and the coupling section 2. At this time, the first radio phone section 3

outputs a call arrival notice signal to the phone operating section 6 to notify the call arrival. The phone operating section 6 receives the call arrival notice signal and sounds a ringing sound 5 to inform the call arrival to the user. The call is received through the operation of the phone operating section 6 by the user so that the communication with the destination is started.

An originator number notice signal is 10 contained in the received call arrival signal to notify the phone number of the call originator. The first radio phone section 3 outputs the originator number notice signal to the originator phone number detecting section 7. The originator 15 phone number detecting section 7 detects an originator side phone number from the originator number notice signal, and stores in the originator phone number storage section 8.

The first radio phone section 3 outputs a 20 connection state signal to the first connection state detecting section 10 to notify a connection state with the destination. The connection state to be said here means whether or not the connection with the destination is continued. The 25 first connection state detecting section 10 detects from the connection state signal that the communication line has been disconnected due to

any reasons after connection with the destination has been established once. One reason is that the reception electric field intensity from the base station received by the first radio phone section 3 becomes weak so that the reception often becomes impossible. At that time, the first connection state detecting section 10 outputs a connection switching signal to the automatic call origination control unit 9.

10 The automatic call origination control unit 9 generates a read request signal in response to the connection switching signal. The originator phone number storage section 8 outputs the originator phone number to the automatic call
15 origination control unit 9 in response to the read request signal from the automatic call origination control unit 9. The automatic call origination control unit 9 receives and sends the read originator phone number to the system
20 selecting section 5 together with the system specification data to specify the second radio phone section 4.

 It should be noted that the destination phone number is contained in the call origination
25 request signal from the system selecting section 5. Therefore, when the call is originated to the destination phone number using the first radio

phone section 3, the destination phone number may be stored in the originator phone number storage section 8 like the received call arrival signal.

Next, the operation of the automatic call origination control unit 9 will be described with reference to an operation flow chart shown in Fig. 4.

In a step 401, the first connection state detecting section 10 outputs a line disconnection detection signal as the connection switching signal based on the connection state signal from the first radio phone section 3. The automatic call origination control unit 9 continues to monitor the connection switching signal from the first connection state detecting section 10.

When receiving the connection switching signal from the first connection state detecting section 10, the automatic call origination control unit 9 detects the line disconnection (step 401). Then, the automatic call origination control unit 9 issues the read request signal to the originator number storage section 8 to inquire the phone number of the connected destination (Step 402) and reads the phone number of the connected destination from the originator number storage section 8 (step 403).

Then, the automatic call origination

control unit 9 outputs a reconnection call origination request signal, the destination phone number data, and the system specification data which specifies the second radio phone section 4, to the system selecting section 5. As a result, a call is originated from the second mobile phone system to the destination phone number (step 404).

The system selecting section 5 selects the second radio phone section 4 based on the system specification data, as in the case where the call origination request signal is sent from the phone operating section 6. The system selecting section 5 outputs the call origination control signal and destination phone number data supplied from the automatic call origination control unit 9 to the second radio phone section 4. The second radio phone section 4 receives the call origination control signal and performs the call originating operation based on the destination phone number data in response to the call origination control signal.

Next, the mobile phone according to the second embodiment of the present invention will be described with reference to Fig. 2. In Fig. 2, the same components as those of the first embodiment are allocated with the same reference

numerals, respectively.

In the mobile phone in the second embodiment, when the reception electric field intensity of the reception signal from the base station becomes weak during the communication with the destination as in the first radio phone section 3 in the first embodiment, the communication line using the first radio phone section 3 is disconnected, and a call is automatically originated to the same connection destination from the second radio phone section 4, if the reception electric field intensity in the second radio phone section 4 is enough strong.

The mobile phone in the second embodiment is composed of an antenna 1, a coupling section 2, a first radio phone section 3, a second radio phone section 4, a system selecting section 5, a phone operating section 6, an originator phone number detecting section 7, an originator phone number storage section 8, an automatic call origination control unit 9', a first reception electric field (REF) detecting section 11, and a second reception electric field (REF) detecting section 12.

As described above, the mobile phone in the second embodiment is composed of the first radio

phone section 3 to connect to the first mobile
phone system and the second radio phone section 4
to connect to the second mobile phone system to
connect to two radio phone systems. Also, the
5 respective radio phone sections 3 and 4 are
connected to the antenna 1 through the coupling
section 2. It is possible to connect the first
radio phone section 3 and the second radio phone
section 4 to the respective systems at the same
10 time. The mobile phone is composed of the phone
operating section 6 used to perform the
operations necessary to perform a call
originating operation and a call arriving
operation. When the call originating operation is
15 performed, the desired system specification data
and the desired destination phone number are
inputted from the phone operating section 6.
Then, the phone operating section 6 outputs the
call origination request signal to the system
20 selecting section 5 together with the inputted
data.

Next, an operation of the system selecting
section 5 will be described with reference to the
operation flow chart of the system selecting
25 section 5 of Fig. 3.

When receiving the call origination request
signal (Step 301), the system selecting section 5

selects one of the first radio phone section 3
and the second radio phone section 4 as the
current use radio phone section based on the
system specification data in response to the call
5 origination request signal (Step 303 or step
306). The system selecting section 5 outputs a
call origination control signal to the selected
radio phone section such that a call is
originated to the destination phone number (Step
10 305 or step 307).

Next, the call arriving operation when a
call is received by the first radio phone section
3 will be described.

As shown in Fig. 6, it is supposed that the
15 first radio phone system covers an area 30 and
the second radio phone system covers an area 32.
In this case, the first and second radio phone
systems have base stations A and B in the areas,
respectively. Also, it is supposed that a user X
20 receives a call originated from a user Y at the
outdoor of a house.

First, the first radio phone section 3
receives an arrived call through the antenna 1
and the coupling section 2, and outputs the call
25 arrival notice signal to the phone operating
section 6 to notify the call arrival. The phone
operating section 6 receives the arrival notice

signal to sound a ringing sound for informing the call arrival to the user. The mobile phone accepts the arrived call through the operation of the phone operating section 6 by the user such
5 that the communication with the destination is started.

An originator number notice signal is contained in the received call arrival signal to notify the phone number of the call originator
10 side. The first radio phone section 3 outputs the originator number notice signal to the originator phone number detecting section 7. The originator phone number detecting section 7 detects an
15 originator side phone number from the originator number notice signal to output to the originator phone number storage section 8. The originator phone number storage section 8 stores the phone
20 number of the call originator side. Also, the originator phone number storage section 8 outputs the originator phone number to the automatic call origination control unit 9' in response to a read
25 request signal from the automatic call origination control unit 9'. The operations described here are the same as those of the first embodiment.

Further, the first radio phone section 3 outputs a signal indicative of the reception

electric field intensity from the base station to the first reception electric field detecting section 11. The first reception electric field detecting section 11 determines whether or not the reception electric field intensity is sufficient for the communication using the communication line connected to the first radio phone section 3, based on the reception electric field intensity signal. That is, it is determined whether the reception electric field intensity is stronger than a predetermined level. When it is determined that the continuation of the communication is impossible, the first reception electric field detecting section 11 outputs a connection continuation alarm signal to the automatic call origination control unit 9'.

Also, the second radio phone section 4 outputs a signal indicative of the reception electric field intensity from the base station to the second reception electric field detecting section 12. The second reception electric field detecting section 12 determines whether or not the reception electric field intensity is sufficient to newly connect a communication line, based on the reception electric field intensity signal. That is, it is determined whether the reception electric field intensity is stronger

than a predetermined level. When it is determined that the communication is possible, a connection possible notice signal is outputted from the second reception electric field detecting section 12 to the automatic call origination control unit 9'.

Next, an operation of the automatic call origination control unit 9' will be described with reference to the operation flow chart shown in Fig. 5.

The automatic call origination control unit 9' receives the connection continuation alarm signal from the first reception electric field detecting section 11 and determines whether or not the communication using the first radio phone section 3 is possible to be continued (Step 501). Next, when it is determined that the continuation of the communication is impossible, the automatic call origination control unit 9' executes the next determination. That is, the automatic call origination control unit 9' determines whether or not the communication using the second radio phone section 4 is possible, based on whether or not the connection possible notice signal is sent from the second reception electric field detecting section 12 (Step 502).

As the result of this determination, if

there is the connection possible notice signal, the automatic call origination control unit 9' outputs a line disconnection request signal to the first radio phone section such that the communication line is disconnected (Step 503). Then, the automatic call origination control unit 9' outputs a read request to the originator number storage section 8 to inquire the phone number of the destination which has been connected (Step 504), and reads the destination phone number (Step 505). The automatic call origination control unit 9' outputs a reconnection call origination request signal to the system selecting section 5 with the system specification data such that a call is originated to the destination phone number from the second radio phone section 4 (Step 506).

The system selecting section 5 selects the second radio phone section 4 based on the system specification data, as in the call origination request signal sent from phone operating section 6. Then, the system selecting section 5 outputs the call origination control signal and the destination phone number to the second radio phone section 4 such that a call is originated to the destination phone number from the second radio phone section 4. The second radio phone

section 4 receives the call origination control signal and performs the call originating operation based on the destination phone number in response to the call origination control
5 signal.

For example, it is supposed that the user X receives the call originated from the user Y through the base station A which covers an area 30, using the first radio phone section 3, as
10 shown in Figs. 6 and 7. A response is sent from the user X to the user Y. Thus, the communication between the user X and user Y can be made possible. In this case, the phone number of the user Y is stored in the originator phone number
15 section 8.

Next, it is supposed that the user X goes into the area in which the reception electric field intensity from the base station A is weak. For example, the user X goes to the shadow of a
20 building and goes into the house. At this time, if the communication is performed through the first mobile phone system through the base station A, the communication sometimes becomes impossible. The decrease of the reception
25 electric field intensity is detected by the first reception electric field detecting section 11.

However, in the mobile phone of the present

invention, when the reception electric field intensity becomes weak, the communication is ended by the first radio phone section 3. Then, a call is automatically re-originated through the base station B to the destination to which the communication with the first mobile phone system is performed, using the second mobile phone system. That is, the connection continuation alarm signal is outputted to the automatic origination control section 9'. The automatic origination control section 9' controls the system selecting section 5 such that the communication with the user Y can be continued using the second radio phone section 4. Thus, even when the connection with the user Y is broken once, the reconnection is automatically performed without reading of the phone number of the destination from the memory for dialing or without dialing during seeing a memo.

Especially, when the communication is started based on the call arrival from the destination, it is impossible to re-originate a call heretofore, if there is not means for knowing the phone number of the destination. However, in the present invention, because means for detecting and storing an originator phone number is provided, it is possible to know the

phone number of the destination and it is also possible to re-originate a call.

Also, generally, systems different from each other in the service area are assumed as the first mobile phone system and the second mobile phone system. For example, the outdoor service of a relatively wide area is performed in the first mobile phone system (the area 30 of Fig. 6). However, the service is not provided for the shadow and indoors of a building. On the contrary, service is mainly provided for the shadow and indoors of the building in the second mobile phone service (the area 32 of Fig. 6). For example, considering the mobile phone systems in Japan, a portable digital phone (PDC) is used as the first mobile phone system and a PHS is used as the second mobile phone system.

That is, when the communication is broken because of movement of the user into the indoor while the communication is performed using the PDC, it is possible to automatically perform reconnection using the PHS. Also, in a case where the service for the indoors is provided by the first mobile phone system and the service for the relatively wide area is provided by the second mobile phone system, the effect of the present invention can be attained similarly. For example,

even if the user suddenly goes out to outdoors,
the communication can be continued.

Further, because the detection level of the
reception electric field intensity indicating
5 that the continuation of the communication is
improper can be optionally set to the first
mobile phone system in the mobile phone of the
second embodiment. In this case, if the reception
electric field intensity is enough in the second
10 mobile phone system, it is possible to switch the
connection from the first mobile phone system to
the second mobile phone system before the
reception electric field intensity of the first
mobile phone system becomes weak. As a result,
15 the quality of the communication is never
degraded.

In the mobile phone which can correspond to
two systems, it is
possible to say that the success probability of
20 the reconnection is quite high, because the re-
dial is performed using the different system.

It would be thought that the mobile phone
which can correspond to two systems, as in the
present invention, is widely used around the
25 world in the future. Especially, when the
coverage areas are considered in unit of service
providers in the North America, it is seemed that

one of a cellular system using a 800-MHz frequency band and a PCS system using a 1.9-GHz frequency band covers an area which is not covered by the other. In such a case, if the first mobile phone system corresponds to the cellular system using the 800-MHz frequency band and the second mobile phone system corresponds to the PCS system using the 1.9-GHz frequency band, it is possible to automatically perform reconnection in both of the coverage area of cellular system and the coverage area of the PCS system.

Instead, a PHS system is selected while a user is in the coverage area which is narrow but cheap in call charge. When the user moves out of the coverage area of the PHS system in some reason during the communication, a call may be re-originated using a PDC system in which the call charge is high but the coverage area is wide.

The above description is given taking the PDC system, the PHS system, the cellular system as examples. However, the first and second mobile phone systems of the present invention are not limited to them. The present invention can be applied to other new systems which provide radio phone service.

Also, in the above explanation, it is

possible to be switched from only a predetermined one of the two radio phone sections to the other. However, it would be apparent that the present invention may be constructed such that it is
5 possible to be switched from one of a plurality of radio phone sections to another.

Further, in the above description, the phone number of a destination is stored in a storage section when a call from an originator is
10 received. However, it would be apparent that the present invention may be constructed such that the phone number of the destination is stored, when a call is originated from the mobile phone.

As mentioned above, according to the
15 present invention, the mobile phone can be provided which can recover a communication even when the reconnection by an identical system is difficult.

Each feature disclosed in this specification (which term includes the claims) and/or shown in the drawings may be incorporated in the invention independently of other disclosed and/or illustrated features.

Statements in this specification of the "objects of the invention" relate to preferred embodiments of the invention, but not necessarily to all embodiments of the invention falling within the claims.

The description of the invention with reference to the drawings is by way of example only.

The text of the abstract filed herewith is repeated here as part of the specification.

In a mobile phone, a first radio phone section (3) is connected to an antenna (1), and corresponds to a first radio phone system. Also, a second radio phone section (4) is connected to the antenna, and corresponds to a second radio phone system different from the first radio phone system. A first state detecting section (10) detects a communication state between a destination and a current use radio phone section as one of the first radio phone section and the second radio phone section. The other is an alternate radio phone section. A control section (5, 9) controls the current use radio phone section to disconnect a first communication line between the destination and the current use radio phone section based on the detecting result by the state detecting section. Also, the control section controls the alternate radio phone section to establish a second communication line between the destination and the alternate radio phone section.

CLAIMS

1. A mobile phone comprising:

an antenna;

a first radio phone section connected to said antenna, and corresponding to a first radio phone system;

a second radio phone section connected to said antenna, and corresponding to a second radio phone system different from said first radio phone system;

detecting means for detecting a communication state between a destination and that one of the radio phone sections currently being used; and

control means for disconnecting a first communication line between the destination and the currently used radio phone section based on the communication state detected by said detecting means and for controlling the other of said radio phone sections to establish a second communication line between said destination and the other radio phone section.

2. A mobile phone according to Claim 1, further comprising second detecting means for determining whether the establishment of said second communication line between said destination and said other radio phone section is possible, and for outputting a call possible signal when it is determined that the establishment of said second communication line between said destination and said other radio phone section is possible, and

wherein said control means controls said other radio phone section to establish said second communication line between said destination and said other radio phone section in response to said call possible signal.

3. A mobile phone according to Claim 1 or 2, wherein one of said first radio phone section and said second radio phone section is preset as said currently used radio phone section.

4. A mobile phone according to Claim 1 or 2, wherein one of said first radio phone section and said second radio phone section is assigned as said currently used radio phone section by system specification data input by a user.

5. A mobile phone according to Claim 1, wherein said detecting means outputs a line disconnect signal based on a first electric field intensity received by said currently used radio phone section, and

wherein said control means controls said currently used radio phone section to disconnect said first communication line between said destination and said currently used radio phone section in response to said line disconnect signal.

6. A mobile phone according to Claim 5, wherein said detecting means outputs said line disconnect signal when said received first electric field intensity is lower than a predetermined level.

7. A mobile phone according to Claim 2, wherein said second detecting means outputs said call possible signal based on a second electric field intensity received by said other radio phone section, and

wherein said control means controls said other radio phone section to connect said second communication line between said

destination and said other radio phone section in response to said call possible signal.

8. A mobile phone according to Claim 7, wherein said second detecting means outputs said call possible signal when said received second electric field intensity is lower than a predetermined level.

9. A mobile phone according to any preceding claim, further comprising phone number storage means for storing a phone number of said destination, and

wherein said control means reads out said destination phone number from said phone number storage means and controls said other radio phone section to establish said second communication line between said destination and said other radio phone section based on the read out destination phone number.

10. A mobile phone according to Claim 9, further comprising phone number detecting means for detecting said destination phone number from a call arrival signal for a call originated from said destination and for storing said destination phone number in said phone number storage means.

11. A mobile phone according to Claim 10, wherein said phone number detecting means stores said destination phone number in said phone number storage means when said first communication line is established between said destination and said currently used radio phone section in response to a call origination using

said currently used radio phone section.

12. A mobile phone according to Claim 1, wherein said control means includes:

system selecting means for selecting said currently used radio phone section from said first radio phone section and said second radio phone section based on first system specification data and said other radio phone section from said first radio phone section and said second radio phone section based on second system specification data; and

automatic call origination control means for automatically outputting said second system specification data to said system; selecting means based on the communication state detected by said detecting means.

13. A mobile phone according to any preceding claim, wherein one of said first radio phone section and said second radio phone section is a radio phone section which corresponds to a PHS system and the other radio phone section is a radio phone section which corresponds to a PDC system.

14. A mobile phone according to any of Claims 1 to 12, wherein one of said first radio phone section and second radio phone section is a radio phone section which corresponds to a cellular phone system and the other radio phone section is a radio phone section which corresponds to a PCS system.

15. A method of controlling communication between a destination

and a mobile phone, said method comprising the steps of:

performing establishment of a first communication line between a destination and a currently used radio phone section;

detecting a communication state between said destination and said currently used radio phone section;

disconnecting said first communication line between the destination and said currently used radio phone section based on the detected communication state; and

performing establishment of a second communication line between said destination and another radio phone section when said first communication line is disconnected based on the detected communication state between said destination and said currently used radio phone section.

16. A method according to Claim 15, further comprising the steps of:

determining whether the establishment of the communication line between said destination and said another radio phone section is possible; and

generating a call possible signal when it is determined that the establishment of said second communication line between said destination and said another radio phone section is possible,

the establishment of said second communication line between said destination and said another radio phone section being in response to said call possible signal.

17. A method according to Claim 15 or 16, wherein said currently used radio phone section is preset from one of a first radio

phone section and a second radio phone section.

18. A method according to Claim 15 or 16, wherein one of a first radio phone section and a second radio phone section is assigned as said currently used radio phone section by system specification data inputted by a user.

19. A method according to Claim 15, wherein said detecting step includes generating a line disconnect signal based on a first electric field intensity received by said currently used radio phone section, and

wherein said disconnecting step includes disconnecting said first communication line between said destination and said currently used radio phone section in response to said line disconnect signal.

20. A method according to Claim 19, wherein said detecting step includes generating said line disconnect signal when said first received electric field intensity is lower than a predetermined level.

21. A method according to Claim 16, wherein said detecting step includes generating said call possible signal based on a second electric field intensity received by said another radio phone section, and

wherein establishment of said second communication line between said destination and said another radio phone section is performed in response to said call possible signal.

22. A method according to Claim 21, wherein said detecting step includes generating said call possible signal when said second received electric field intensity is lower than a predetermined level.

23. A method according to Claim 15, further comprising the step of storing a phone number of said destination, and
wherein said step of establishing the second communication line includes:

reading out said destination phone number; and

establishing said second communication line between said destination and said another radio phone section based on the read out destination phone number.

24. A method according to Claim 23, comprising the steps of:
detecting said destination phone number from a call arrival signal for a call originated from said destination; and
storing said destination phone number.

25. A method according to Claim 24, comprising the step of storing said destination phone number when said first communication line is established between said destination and said currently used radio phone section in response to a call origination using said currently used radio phone section.

26. A method according to Claim 15, wherein said step of establishing the second communication line includes:

selecting said another radio phone section based on system

specification data; and

automatically generating said system specification data based on the detected communication state of said first communication line.

27. A method according to Claim 15, wherein one of said currently used radio phone section and said another radio phone section communicates using a PHS system and the other radio phone section communicates using a PDC system.

28. A method according to Claim 15, wherein one of said currently used radio phone section and said another radio phone section communicates using a cellular phone system and the other radio phone section communicates using a PCS system.

29. A mobile phone substantially as herein described with reference to and as shown in Figure 1 or 2 of the accompanying drawings.

30. A method of controlling communication between a destination and a mobile phone substantially as herein described with reference to Figure 3 of the accompanying drawings.



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Claims searched: 1 to 30

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:
UK Cl (Ed.Q): H4L (LECX, LDSHE)
Int Cl (Ed.6):
Other: Online: WPI, JAPIO, EPODOC

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X, E	GB 2327573 A (NEC) see abstract	1, 15
X, P	GB 2320659 A (NEC) see abstract	1, 2, 9, 15, 16, 23
X	GB 2296626 A (NOKIA) see abstract	1-3, 5-8, 12, 14-17, 19-22, 28
X	GB 2292286 A (MOTOROLA) see whole document	1-4, 15-18

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

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